

TITLE OF THE INVENTION

STREAMING MEDIA QUALITY ANALYZER SYSTEM

BACKGROUND OF THE INVENTION

5 The present invention relates to streaming media, and more particularly to a streaming media quality analyzer system for measuring the quality of reception at remote sites.

Media service providers (MSPs) have a goal of providing customers with streaming media, such as video/audio data, over a network, such as the Internet. Because of bandwidth limitations of the network and the wide bandwidth nature of video data, for example, data compression is required, such as MPEG2 and the like, to reduce the bandwidth of the data to fit within the bandwidth constraints of the network. The compressed data is packetized and transported over the network to the customer at a remote site.

10 The streaming nature of video favors using connectionless data packets, such as UDP packets, for sending the video packets over the network. Being connectionless, the UDP packets do not assure that all of the packets are received by the customer. If some of the packets are lost or displaced as a result of network losses, when decoded these packets produce defective data, such as impaired video. This is an irritant to the customer, and therefore the MSP needs to determine when there are network problems that are affecting the quality of the steaming media as viewed by the customer. Alternatively using TCP/IP protocol, occasional loss of a packet maps into a delay in packet delivery, as the missing packet gets re-transmitted.

What is desired is a streaming media quality analyzer system that detects when defective data is being received by the customer so that a media service provider can take steps to remedy the situation and alleviate the irritant to the customer.

5

BRIEF SUMMARY OF THE INVENTION

Accordingly the present invention provides a streaming media quality analyzer system that compares original streaming media from a source, or original packetized streaming media from the source, with a reconstructed packetized streaming media representing the packetized streaming media as received over a network at a remote site. At the remote site the received packetized streaming media is analyzed to determine time of arrival of the packets which includes identification of missing packets. The analysis results are transmitted over the network manner to a measurement site and used to reconstruct the received packetized streaming media from the original packetized streaming media. The reconstructed packetized streaming media is then analyzed to determine the quality of the packetized streaming media received at the remote site.

10

15

20

The objects, advantages and other novel features of the present invention are apparent from the following detailed description when read in conjunction with the appended claims and attached drawing.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Fig. 1 is a block diagram view of a streaming media quality measurement system according to the present invention.

Fig. 2 is a block diagram view of a network-centric streaming media quality measurement system according to the present invention.

Fig. 3 is a block diagram view of a streaming media quality measurement system when the original source is not available according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to Fig. 1 a streaming media signal, such as video/audio data, from a source **12** is input to an encoder **14** for data compression according to a standard compression scheme, such as MPEG2, MPEG4 or the like for video. The compressed media from the encoder **14** is packetized by a server **16** into data packets, such as UDP (User Datagram Protocol) packets. UDP is a transport layer protocol that allows an application program on one host to sent a connectionless datagram to an application program on another host. This protocol is used for traffic, such as streaming video/audio, generated by applications that can't adapt their timing behavior to network conditions. The packets are transported from the server **16** over a network **18**, such as the Internet, to a receiver **20** at a remote site. The receiver **20** receives the transport layer with the data packets as affected by transport over the network and extracts the data packets containing the compressed media. The data packets are decoded by a decoder **22** and the resulting

decoded media is processed by a graphics card **24** for viewing on a display **26**. This is a standard streaming media system for transmitting time sensitive information from a source over a network to a receiver. If some of the packets are missing or displaced in sequence as the result of network losses, the media viewed on the display **26** or the protocol (MPEG2, etc.) required to decode the image is degraded.

At the headend or originating end the original media signal also may be input to a media (video/audio) quality analyzer **28**. The data packets from the server **16** are input to a reception emulator **30**. At the remote site the received packets from the receiver **20** are input to a reference server **32** in which details of their arrival or the time they are received by the decoder are taken, such as the time of arrival and sequence number of these IP packets and/or their payloads. This information, which has just a few numbers for each video frame received, is encoded as signal data packets in a connected transport layer, such as a TCP/IP transport layer, and is transmitted via a signal link **34**, which also may be the Internet, to the reception emulator **30**. The Transmission Control Protocol (TCP), part of the Internet Protocol (IP) suite, is a protocol used to establish a connection between end systems for the reliable delivery of data and sets up a two-way connection between the headend and the reception end. Alternatively the information may be returned to the headend using RTP/RTCP (Realtime Transport Protocol and Realtime Transport Control Protocol) protocols according to the IETF standard. These protocols ride as an application sublayer on top of UDP to

provide time stamping, delivery monitoring and sequence numbering, and provide a mechanism for hosts involved in an RTP session to exchange information, such as packet counts, packets lost, interarrival jitter, etc. At the reception emulator **30** the information regarding the timing of arrival or loss of the signal data packets from the remote site is used to reconstruct or reassemble the original data packets from the server **16** according to the information received from the remote site to resemble the packet arrangement at the remote site. Thus a replica of the defective streaming media at the remote site is created. The reconstructed received data packet train is then input to a decoder **36** to recover the impaired media as seen at the remote site or may be input to a protocol analyzer to ensure protocol compliance. The impaired media may also be input to the media quality analyzer **28** for comparison with the original media. The media quality analyzer **28** provides a quantitative measure of the degradation of the received media with respect to the original media using either a "single-ended" measurement algorithm on the reconstructed streaming media or a "double-ended" measurement algorithm, such as a Human Vision Model or a Reduced Reference Model for video. The collection of a very limited amount of defect descriptor data at the remote site does not significantly load the remote site.

An alternative embodiment, as shown in Fig. 2, rather than using the original media from the source **12** as the reference media for the media quality analyzer **28**, the media for input to the reference input of the media

quality analyzer **28** is derived via another decoder **38** from the original data packets from the server **16**.

In yet another embodiment when access to the source media is denied or not available is shown in Fig. 3, a test receiver **40** at a measurement site receives the data packets from the network **18**. An original packet
5 reconstructor **42** receives the data packets from the test receiver **40** to produce a reconstructed packet train corresponding to the original packet train transmitted from the (unavailable) source. The reference stream is built by successively reacquiring streaming media from the source for a typical
10 "video on demand" system. The reconstructed original packet stream is then processed together with the defect descriptor data from the remote site as in Fig. 2 above.

Additional data returned from the remote site may be information on computer graphics cards used there, as these also have an impact on media
15 quality. Also MPEG stream analysis may be performed instead of rendered video quality analysis as described above. Audio streaming quality may also be measured as described above.

Thus the present invention provides a streaming media quality analyzer system by having a remote site analyze received data packets and
20 provide the resulting details via a signal link to a measurement site so that the remote site data packets may be reconstructed from the originally transmitted data packets for quality analysis.